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GEOGRAPHICAL EDUCATION*

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WHEN asked to open this discussion I naturally considered, in the first instance, what, under present circumstances, was the right note for an opener to strike. Ought I to be severely practical, and, if possible, usefully hintful; or, on the other hand, should I suggest ideals towards which we might strive — and run the risk of being condemned by some as unpractical? The question was a difficult one, because at this moment we are obviously searching our educational minds, and both courses would have their value. At the present juncture there are probably many people ready to experiment upon practical hints; and, on the other hand, the present is a time when curricula are being reconsidered, when the new Authorities are planning their first action. and when a larger grasp of the subject might also have its use. In the printed paper which is in your hands I have attempted to combine the advantages of both courses, and it must be for subsequent speakers to select the particular line they may think useful.

Then there was another important question to be settled. In speaking on geographical education, or, as I should prefer to put it, on geography *in* education, was I to limit my attention to some chief type of school or to speak more generally? I would appeal to those who may take part in this discussion to remember, at each stage of the discussion, how varied are the problems in different kinds of schools, and yet to consider whether there is not some method essential to geography, applicable with variations to all stages and types of education.

Having these difficulties in view, I have printed for your discussion

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what may perhaps be described as a standard course—no doubt beyond the possibilities of many schools by reason of existing limitations but still, on the whole, the most generally desirable thing as it seemed to me. I may say that I have already heard criticisms of it, from at least two points of view, which concern the three conditions I lay down at the outset. Well, the idea which appears to me to be at the root of any adequate teaching of geography, and of any adequate recognition of the subject in education, is that we must treat it as a discipline and not simply as a mass of information. Now, if that is to be the case, we must realize the conditions under which the older studies, like the classics and mathematics, have attained to their present value as disciplines. I do not know whether I shall find general agreement, but it seems to me a special characteristic of these subjects that, owing to the experience of centuries, they have been made progressive in method. In the case of mathematics there is, of course, a logical method inherent in the subject; but in the case of a language there is no necessary method apart from that which has become traditional as the result of great experience. It would be possible to attack the learning of a language in various ways; but our classical languages have become, and we hope by degrees our modern languages are becoming, effective educational disciplines because a particular method—with variations no doubt, and with improvements as time goes on, but still a particular method—has been threshed out as the result of centuries of work. In other words, we have in Latin and Greek and in mathematics subjects which can be taught by such successive stages that they can be employed for the development of the mind from the age of eight or nine to that of twenty-two or twenty-three. Now, if geography is to be generally accepted as a valued discipline and not merely admitted to the curriculum because imposed by a public opinion, it seems to me that it must be characterized by a similar progression of method. You must recognize that the mind is being stretched, and in each successive year you must employ more effective, or rather, more nearly mature, methods, and not learn of successive regions by precisely the same methods at all stages of mental development. That point I would put as the basis of discussion—that we must have a method in the subject which shall be progressive and appropriate for expanding the mind through a series of years.

Under ideal circumstances it appears to me that three conditions should be fulfilled if we are to realize such progression of method. In the first place, the pupils in a school should be classed in special "sets" for geography exactly as they are now often classed for mathematics

or for modern languages; otherwise they run great risk of omitting essentials in the argument. I hear a criticism that, looking at the present conditions of education, this is impossible. With an unsympathetic head master it is obviously impossible. But my reply is that at this moment I have a public school in mind—I can not mention the name without permission: it is not one of the first half-dozen of our public schools, but stands high in the next flight—whose head is, I believe, willing to try the experiments of arranging his school in "sets" for geography and of placing the geography of the whole school under one master. He will even yield to our geographical requirements so far as to permit at any rate one excursion to some view point in the course of the year. If you could get a rare master here and there to try experiments of this kind, a long step forward would have been taken; for it seems to me more desirable, in the first instance, to strike a keynote in important quarters than to "level up" more generally to some more or less unsatisfactory compromise. Our declared aim should be to win recognition for geography, especially in secondary and higher education. We should boldly challenge for it a place in higher education; and in proportion to our success there will it be developed and improved in the elementary schools. For that reason I value any opportunities which we may set in opposition to those who criticize our aims from the *non possumus* position.

With regard to the arrangement of geographical sets and the appointment of an expert master to take charge of geographical teaching for the whole school, I recognize at once that in many schools compromises may be necessary, and I have put this forward simply as an ideal towards which we ought to strive. I believe that the master who is a specialist will in the long run set the pace, and that others will profit by his lead. What, however, is essential is that we should agree generally upon our progressive method. Well, now, in schools at present —and it has been so for a long time past—geography is too often split into two subjects, commonly called "general geography" and "physical geography," as though all geography that is worth knowing were not fundamentally physical. The real contrast lies not between two subjects, but between two different principles of arranging the same subject. I can indicate them in a few words thus: You may arrange the facts of geography either according to categories, according to the chapter-headings of a text-book, considering successively climates, volcanoes, the distribution of plants, and so forth; or you may arrange them according to regions, taking such units as England, France, India, and such

like. "Physical geography," according to common parlance, implies the arrangement according to categories, and "general geography" that according to regions. But the general geography at present usually taught is incidental to history, and the physical element is largely eliminated from it. On the other hand, the physical geography is taught as a series of chapters from other sciences—elementary physics, elementary botany, geology, zoölogy, meteorology, and so forth. Thus your physical geography lacks unity; and, though I don't say that there is no value in such a study, yet as a discipline it is obviously less valuable than it might be. On the other hand, your general geography, from which the physical element is so largely eliminated, contains none the less a unifying element—namely, topographical distribution—which is of the very essence of geography. I venture to think that, if we are to make a progressive study of geography, fitted for education through a series of years, we must adopt that classification which gives unity. But, if, as a consequence, you adopt the regional basis, you are at once faced with this difficulty—that each region, as you discuss it, postulates a background of knowledge of various kinds. For instance, if you are discussing England, you require a little geological knowledge to understand its physical features, a little meteorological knowledge to understand the contrasts of its climates, a little botanical knowledge to understand why there are differences of *flora* at different heights, a little historical knowledge, a little economic knowledge, and so forth. Your main difficulty, if you take the regional method as a basis, is that you seem to demand from the very beginning a background of knowledge. But I suggest that it is possible to adopt the regional basis and yet to go to the physical root of the matter by introducing your auxiliary sciences, one at a time, at successive stages of your progression.

In order to indicate my meaning I have mapped out in six stages what I think should be a possible course of study. The first is the elementary stage, and we start, of course, with the home. But the home exemplifies matters both of local and of world-wide interest. Your home study must obviously include the immediate surroundings — the hill, the bridge, the village of the neighborhood; but it is common experience that there are also some larger things which even the most stay-at-home person sees almost as well as the person who travels. For instance, any one living in the Fens may study cloud effects, the rising and setting sun, the Pole-star, the horizon; in fact, any of the great universal phenomena of the world. Here, then, you have a double beginning for geography: the home and the globe. In the earlier stages of elementary education you should deal with actual facts, and if you are to

make use of any material aids to instruction, other than the objects themselves, it should always be a globe, or part of a globe, and not a map on the flat. But the main thing is to see the objects themselves.

When Lord Salisbury once recommended the use of large maps in order to understand international politics I could not help feeling that he was referring in his own mind to some experience of mature life when he suddenly related the map with vividness to the reality, and recognized a void in his early education. Certainly I myself, although I have been engaged in teaching geography for a good many years, realized only a short time ago one of the things that ought to have come home to me when I was young. I was on the Atlantic; there was a cloudless sky; the sun was setting, and for the first time, I really *felt* the horizon rise over the face of the sun, and not the sun sink below the horizon. Now I maintain that the teacher should strive to make the pupil see the Pole-star as fixed in the heavens, the other stars going round it, the sun rising and setting, and so forth, as realities, and as merely symbolized by the use of the artificial globe. I anticipate that one of the first criticisms will be that all this would take much time. Precisely so, but in proportion as an idea is worth having is it worth taking time in order to impress and implant it in the mind for a lifetime. In elementary geographical education infinitely better than the attempt to teach much is the attempt to drive home the great facts again and again and again and from different points of view until they become living parts of the mind and ineffaceable till death.

The artificial globe in the first instance should have no map upon it. Then when the home on the one hand and the planet on the other have been seized, you may proceed to locate the home and to clothe the planet with the outlines of the map. I recognize that in what is commonly called elementary education—that is, the education of those who are not going far in a school career, but straight into life—there should enter here a stage that may perhaps be described as a foreshortened secondary education. You are obliged to put into the last parts of common elementary education certain things which might safely be postponed in the case of those who have the chance of a longer education. On this point I would ask you not to conclude that because I do not stay to discuss it I am not conscious that there is more to be said on the elementary stage. Time compels me to pass to secondary education, to the four succeeding stages of my printed scheme.

In the first stage, or elementary education, we consider the home. In the second stage, at the beginning of secondary education, we come to what I call the home area, in the third we shall deal with the home

country. in the fourth with the home region, and in the fifth with the world's surface generally. You will see that we go steadily expanding outwards, but always upon the regional basis. I think that it is because the idea of my second stage, the home area, has been omitted in almost every system of geographical education that we have never sufficiently correlated the study of the home with that of geography at large. You can not safely go, at one leap, from the home to the home country, say the British Isles. I mean by the home area that every child in London should study, say, the Thames Basin and the Weald, and every child in the North some area as large as, say, Lancashire and Yorkshire. My reason is this: If you consider the Thames Basin and the Weald, you have in the chalk strata a great yet simple basis of physical structure. The hills and the valleys all comment on that structure. Similarly in the North you have the great upfold of the Pennines as a basis for the rational discussion of the topography. Geologists have long been asking for some elementary geology in school education, and you hear it replied that in school curricula there is no room for it. My own view is that at this time of day every educated person should be able to analyze a landscape intelligently, and should know what is meant when told of an "escarpment" or an "upfold" of strata. It is not possible to travel intelligently if you do not think of the landscape intelligently. Here, then, it seems to me, as incidental to one stage of a thorough geographical curriculum, is the place for some pertinent geology. The home area. as you see, is much more than the home, and yet it deals only with a few geographical units — river-basins, hill-ranges, and so forth — and it is therefore possible to be thorough in explanation. This is the place, too, to introduce the true map—not the diagram which shows you the American Continent on an octavo page, but the true map—on a scale of one or two miles to the inch, so that you may show the relation to it of the actual land surface. It should be possible even under present conditions to take a class at this stage once or twice during the year to some view point, and to let them correlate the map with the landscape on the spot. And more—they should be asked there on the spot, with the aid of the map, to prolong the landscape, in imagination, beyond the horizon, and so to train the imagination for a real grasp of the next stage.

Now I come to the third period of instruction: that dealing with the home country. Here you expand from the home area, utilizing the ideas and terms there thoroughly learned. You will thus find it possible quickly to indicate relief and essential structure, and to have time for that which is proper to this stage—the climatic contrasts and the applications of meteorology. In the home area you have not space for great

contrasts of climate. True, you get certain small variations, as for instance in the Pennine region, where you have more moisture in Lancashire than in Yorkshire; but that, after all, is a minor matter, and until you get to the whole country you can not appreciate such variations as there are between London and the western Highlands, for example. These you may study by examining the daily weather map in the *Times* newspaper, and may often see one state of weather in London and another, say, on the northwest coast. So, and so only, will climatic contrasts begin to "live" in a pupil's mind. I would concentrate in this year on the geography of the home country, and the addition to the scientific understanding would relate especially to meteorology. At about this age the science master would be assisting by teaching laboratory physics.

In the next stage we come to contrast the home country with the home region in the midst of which the home country lies. Here, no doubt, you must differentiate somewhat according to the type of school. In a commercial school one aspect would be emphasized, in a classical school another. If you have laid the foundation firmly in the earlier stages, your students will have time in this year to relate some of the great political and economic or historical contrasts presented by the home country and other countries to their physical structure and climates.

Next we come to a still higher and more complex stage. It deals with the world as a whole, and you will have to appeal to the whole background of knowledge thus far accumulated. You had the slightest rudiments of astronomy even in the elementary stage Make those precise now and build upon them a knowledge of the world's climates, always referring back to the instances of the home country and the home region. Throughout remember that there is as much art as science in geography: the true geographical teacher will have as much care for proportion and color as an artist exercises in painting a landscape.

Lastly, I come to the stage of University teaching. At Oxford, Cambridge, London, and Manchester experiments in geographical teaching are being tried, or are about to be tried. The two methods of classification are here no doubt appropriate, provided that the secondary training has been adequate. The general classification may often be best for purposes of research. But, after all, geography reaches its highest point in the regional synthesis, where there must be perfect painting of a picture based in every detail upon a carefully acquired foundation of facts. From the Universities ought to go forth secondary teachers and elementary teachers who will each translate what they have learned, with the certainty of a vast background of knowledge, into the simpler forms that are needed in the schools.

I wish to close by meeting what, I have no doubt, will be the general criticism of the practical teacher—that you can not accomplish what I have set forth in the time available. All that I have to say is, *first*, that I ask that more time should be given, because I think, if this subject were being taught in the way I suggest, it would bring great results; but, *secondly*, I say that just in proportion as the time is limited is the right method essential. A progressive method utilizes every gain of the previous years. I believe that, if the principle were adopted of expanding steadily from the home to the world—introducing at each stage a fresh physical contribution or means of analysis, and massing the times given separately in some schools to geography and physiography—that you would be able in the ninety minutes a week (which is about the time given to the subject in a public school) to produce a very valuable result. Allowing for examinations at the end of term, this amounts to some fifty or sixty hours a year.

Four things, then, seem to me necessary for the progress of geographical teaching. First, we should encourage University schools of geography, where geographers can be made, of whom many will become secondary teachers. Secondly, we must persuade at any rate some secondary schools to place the geographical teaching of the whole school in the hands of one geographically trained master. No doubt, in many cases it will be necessary for him to help in other subjects—in history, say, or science—but he must before everything else be a geographer. Thirdly, we must thresh out by discussion and experiment what is the best progressive method for common acceptation, and upon that method we must base our schemes of examination. Lastly, the examination papers must be set by practical geographical teachers. Unless you apply these four methods simultaneously you will fail, because it is useless for the Universities to produce experts if the schools will not employ them; yet the Universities will not provide experts unless the schools offer positions. Again, experts can not work unless examiners give them opportunities; and examinations will be based on differing conceptions unless you have a progressive method more or less generally accepted. The thing can be done, even though our time and our money be limited. All that is wanted is some courage and some determination to hold to a high ideal. If you will but recognize that this is not merely or essentially an elementary subject, then something more can be accomplished than a slight leveling up: you can make geography a scientific study and a discipline that will contribute vitally to the nation's education.

THE PRACTICE SCHOOL COURSE IN GEOGRAPHY IN THE NORMAL SCHOOL, CHARLESTON, ILLINOIS*

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(C) Coastal Lowlands.

(*a*) Atlantic Coastal Plain.

Location. Extent. States wholly or partly included.

Character of surface of plain.

Drainage. Plan of streams on plain.

Plan of those from Appalachians that cross plain.

Falls in most of them that flow from Appalachians across coastal plain. Why?

Influence of fall line on cities. Why?

What prominent cities on fall line?

Shorelines; drowned valleys, bars, lagoons.

Advantages and disadvantages.

Climate.

Study and compare northern and southern parts, as to temperature, rainfall, prevailing winds, summer and winter.

Productions. Locate. Note relation to slopes, soil, water, climate, and markets.

Agricultural.

Tobacco, cotton, rice, oranges, and other fruits.

Truck farming.

Mineral.

Clays, sands, stone, phosphates.

Forestal.

Lumber, resins, tar, turpentine.

Fishery.

Oysters, blue fish, mackerel, sponges.

Manufactural.

Kinds determined by needs more than by native products.

Sugar refining — Brooklyn.

Silk goods — Paterson.

Iron goods — Baltimore.

Ships — Norfolk.

Pottery — Trenton.

*Continued from The Journal of Geography, Vol. II, November, page 469.

Study each city thoroughly as a center of this industry. Bring together materials learned earlier in the course.

Commerce, factors in; development of.

Influence of coast, rivers, producing regions, manufacturing cities, ocean, and foreign markets.

Influence of topography on local and interior trade.

Cities—Philadelphia, Camden, Wilmington, Del., Washington, Annapolis, Newport News, Charlotte, N. C., Jacksonville, St. Augustine, Charleston, S. C., Savannah, Brunswick. Locate, and learn why noted.

Names of cities and their states should be associated.

Locate on outline map the places studied above.

Ref.:—R. & H.—Nat. Adv., pp. 71, 78, 79, 80, 81. Frye—Gram. Sch. Geog., pp. 67, 97, 98–100. Tarr and McM.—N. A., pp. 158–163, 178–180, 200–210, 219, 221, 222. Carpenter—Geog. Reader, N. A., pp. 14–24, 45–57, 99–135.

(*b*) Gulf Coastal Plain.

Study essentially as in case of Atlantic coastal plain.

Cities—Pensacola, Tampa, Mobile, Vicksburg, New Orleans, Galveston, Beaumont, Little Rock, Natchez, Baton Rouge, Shreveport, Houston, Dallas, Oklahoma, Guthrie.

Indian Territory and Indian reservations.

Locate on outline map as before.

Ref.:—R. & H.—Nat. Adv., pp. 51, 78, 79, 81–83. Frye—Gram. Sch. Geog., pp. 67–71, 98–100, 102, 103–106. Tarr and McM.—N. A., pp. 210–230. Carpenter—Geog. Reader, N. A., pp. 135–159. King—Geog. Reader, Bk. IV, pp. 1–43.

(D) Central Lowlands.

(*a*) Prairies.

Study essentially as in case of Atlantic coastal plain, as to location, extent, character of surface, soils, drainage (special study of Mississippi River), climate, products.

Commerce, needs of; development of.

Factors in development of:

Rivers, lakes, and canals (Ill. and Mich., Erie and others); products; markets in the East; need of manufactured articles from the East and from abroad; local trade; level country adapted to railroads; great development of railroads. Locate the leading lines of railroad.

Cities. Locate. Name of city and its state should always be associated. Account for the development and

importance of each city so far as determined by geographic conditions.

Many of these cities will have been introduced under some product. Cleveland, Columbus, Toledo, Akron, Findlay, Detroit, Lansing, Port Huron, Grand Rapids, Ann Arbor, Fort Wayne, Indianapolis, Chicago, Terre Haute, South Bend, Peoria, St. Louis, East St. Louis, Rockford, Springfield, Milwaukee, St. Paul, Omaha, Minneapolis, Dubuque, Kansas City, Davenport, Cairo, Fargo, Council Bluffs, Saginaw, Bay City.

Group cities as lake ports, river ports, grain and stock markets, manufacturing cities, etc. Why so many grain markets? Why so many cities making farm machinery? Use other similar questions tending to unify the work, or introduce comparisons. Make a more extensive and detailed study of Chicago as a modern American city.

Ref.:—R. & H.—Nat. Adv., pp. 51, 72–76, Illinois Supplement. Frye—Gram. Sch. Geog., pp. 71, 106–114, Illinois Supplement. Tarr and McM.—N. A., pp. 234–247, 254–256, 261–276. Carpenter—Geog. Reader, N. A., pp. 159–164. Dryer—Studies in Indiana Geog.

Special study of Chicago.

Location.

State, part of state, lake and river.

Railroads (I. C. R. R. and many others), canal.

Size and population; nationalities.

Why so many people and nationalities?

Let succeeding topics answer.

Commercial center.

Factors given under position that help to account for the fact of commercial importance.

Trace water connections with ocean.

New factors.

Relation to the East, to the West, to the South, to the North.

To the grain and stock lands near by.

Products to and from each section.

Made factors.

Railroads, canal, clearing house, banks, custom houses, elevators, harbors, docks and wharves, depots, freight houses.

Notice great number of men needed to operate.

Manufacturing center.

Why? Local needs, and markets near by.

Much raw material going through which can be made up.

Coal near. Distant markets easily reached.

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Hundreds of men needed.
Kinds of manufacturing done.
Meat packing, etc., iron mills, farm machinery and other kinds, furniture, cars, clothing,
Note all geographic factors which minister to these industries.
Educational center.
Number of universities and colleges. Name one or two.
Other schools, pupils and teachers, buildings. A few figures.
Museums and collections, libraries.
Public buildings, etc.
Office buildings; churches; hotels; theaters; post office; parks; streets; boulevards.
Other things about Chicago.
Water works; drainage canal; street cars and Elevated R. R.
Newspapers. Large retail and wholesale houses.
Government; police; fire department. Relation and importance to state.
Compare down town life and activities with life of residence portions. Note several residence portions and compare.
One or two foreign population settlements. Suburbs.
Make the mental picture of "city" as clear as possible.

Ref.:—Tarr and McM.—Home Geog., pp. 170, 171; N. Amer., pp. 262–268. Frye—Gram. Sch. Geog., pp. 107–110; Rocheleau—Great Amer. Industries, Vol. III, pp. 100–127; 160–221. Adams—El. Com. Geog. Index. Lyde—N. Amer., pp. 66, 67. Carpenter—Geog. Reader, N. Amer., pp. 225–234. King—Geog. Reader, Bk. IV, pp. 139–158. Mill—Int. Geog., pp. 740, 741. Baedeker—U. S. Shaler—U. S. Appleton—Gen. Guide. U. S. G. S.—Folio Chicago Plain. R. & H.—Nat. Adv., pp. 42, 43.

(*b*) Lake Superior highlands.
Approximate size of region. What and where?
Nature of surface.
Vegetation.
Account for forests, and the lumber industry.
Note its cities, trade routes, and markets.
Relation of this industry to the industries of the prairies.
Minerals—Iron and copper.
Study these, especially the iron, as to their relation to the development of the industries of the prairies and Allegheny Plateau.
Cities of Lake Superior region—Duluth, Superior, Ishpeming, Marquette, Calumet.
Transportation to the factories of Chicago, Grand Rapids,

Pittsburg, Erie, Saginaw, and Bay City.
Influence of the "Soo" canals.
Why is the iron ore not smelted and manufactured in the mining region?

Ref.:—R. & H.—Nat. Adv., p. 75. Frye—Gram. Sch. Geog., pp. 107, 108. Tarr and McM.—N. A., pp. 252–254, 256–260, 261, 262. Carpenter—Geog. Reader, N. A., pp. 172–189.

(*c*) Ozark Highlands.
Where? What states?
Nature of surface; soils.
Occupations.
Agriculture (grazing), lumbering, mining.
Products.
Stock, lumber, iron, zinc, and lead.
Influence on industries in nearby states.
City—Joplin, Mo.

Ref.:—R. & H.—Nat. Adv., pp. 51, 77. Frye—Gram. Sch. Geog., p. 114. Tarr and McM.—N. A., p. 260.

(E) Western Highlands.
(*a*) Great Plains.
Location; extent. States partly or wholly included.
Relation to prairies and to Rocky Mountains.
Surface. Topographic features; soils.
Drainage. Chief streams, character of.
Climate. Careful study of, as furnishing explanation for character of streams, crops, etc.
Industries of plains as related to the relief and the climate.
Irrigation. Why? Methods and results.
Cities of plains—Great Falls, Mont., Cheyenne, Wyo., Denver and Pueblo, Colo., Deadwood, S. Dak.
Transportation.
Why so little river traffic? Influence on development of country.
Great railroad lines crossing plains—Northern Pacific, Union and Central Pacific, Great Northern, Southern Pacific, Santa Fé.
How did people travel before the day of railroads?
Locate places as usual on outline maps.

Ref.:—R. & H.—Nat. Adv., pp. 52, 77, 83–87. Frye—Gram. Sch. Geog., pp. 71, 104–106, 111–118. Tarr and McM.—N. A., pp. 203, 205, 217, 218, 229, 248–252, 283, 286, 287, 297, 302–308, 312. Carpenter—Geog. Reader, N. A., pp. 164–171.

(*b*) Rocky Mountains.
Location; extent. Correlate with those in Canada.
States included in the area.

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Relation to Cordilleras and rest of western highland.
Character of mountains—ridges, peaks, chains, passes, and parks.
Relation to continental divide.
General altitude. Altitude of special peaks.
Effects of mountains on their own climate and on that of plains to the east.
Vegetation of the Rocky Mountains in various parts, and at various altitudes.
Scenery of Rockies.
Yellowstone Park and others.
Pike's Peak and others.
Trace the great railroads mentioned above through the mountains, noting the control exerted by relief, valleys, and passes upon them.
Occupations and products.
Mining—gold, silver, lead.
Locate chief regions.
Does iron occur? Why is it not worked?
Hunting and trapping. Why?
Cities and their characteristics—Butte, Mont., Cripple Creek, Leadville, Pueblo, Denver, Colo., Santa Fé, New Mex.

Ref.:—R. & H.—Nat. Adv., pp. 52, 84–87. Frye—Gram. Sch. Geog., pp. 64–66, 115–118. Tarr and McM.—N. A., pp. 281–285, 288–294, 308–310. Carpenter—Geog. Reader, N. A., pp. 235–237, 241–258, 284–290. U. S. Dept. Agri. Bull. 10, Life Zones and Crop Zones in U. S.

(*c*) Columbia Plateau.
Location; extent. States included.
Origin; character; soils.
Climate.
Rivers.
Occupations—grazing, wheat growing.
Cities—Spokane.
Possibilities for development in plateau.

Ref.:—R. & H.—Nat. Adv., pp. 52, 88–90. Tarr and McM.—N. A., pp. 284, 285.

(*d*) Colorado Plateau.
Location; extent. States included.
Surface; relief, origin of.
Climate; causes, effects of altitude.
Vegetation.
Special study of Colorado river and canyon. Compare with Mississippi.
Occupations and industries.

People, with brief study of the Indian customs.
Cities—Tucson, Phœnix, Yuma, Prescott.

Ref.:—King—Geog. Reader, Bk. IV, pp. 197–208. R. & H.—Nat. Adv., pp. 52, 86, 87. Frye—Gram. Sch. Geog., pp. 66, 115–119. Tarr and McM.—N. A., pp. 310, 311. Carpenter—Geog. Reader, N. A., pp. 238, 239, 290–297. U. S. G. S. Monograph 2. Dutton, Colorado Canyon. U. S. Dept. Agri. Bull. 10, Life Zones and Crop Zones in U. S.

(*e*) Basin Ranges and Valleys.
Study essentially as for Colorado Plateau.
Under climate note recent changes of climate, and history of Great Salt Lake thus involved.
Cities—Salt Lake City, Ogden, Carson City, Virginia.
Mormons; characteristics.
Influence on development of the region.

Ref.:—R. & H.—Nat. Adv., pp. 52, 87. Frye—Gram. Sch. Geog., pp. 66, 118, 119. Tarr and McM.—N. A., pp. 285–287, 290, 291, 299, 312. Carpenter—Geog. Reader, N. A., pp. 259–264. U. S. G. S. Monographs, Lake Bonneville and Lake Lahontan.

(*f*) Pacific Ranges and Valleys.
Extent and states involved.
Mountain ranges—Sierra Nevada, Cascade, Coast Ranges.
Valleys. California Valley and Puget Sound Valley.
Relief; altitudes of peaks, old volcanoes, etc.
Climate, influence on climate of plateaus.
Seasons—rainy and dry, summer and winter.
Compare northern and southern parts.
Explain on basis of general circulation and migration of wind belts.
Compare with Atlantic coast and explain differences.
Drainage.
Rivers; relation to trend of mountains.
Recall coast line and coast of eastern U. S. and compare.
Importance of the inlets, San Francisco Bay, and Puget Sound on climate, commerce, and general development of country.
Industries and products.
Mining. Locate centers.
Lumbering. Locate centers. Big trees.
Agriculture. Locate centers. Chief products.
Horticulture. Locate centers. Account for.
Fishing. Locate centers.
Hunting. Locate centers.
Transportation.
Commerce of ocean. Exports and imports.

Railroad connections. Continue tracing the lines across to coast cities.

Cities. Locate. Why important? What state?

Los Angeles, San Diego, San Francisco, Oakland, Seattle, Portland, Tacoma, Astoria.

On outline map locate all places mentioned.

Ref.:—R. & H.—Nat. Adv., pp. 53, 88-91. Frye—Gram. Sch. Geog., pp. 66, 119, 120. Tarr and McM.—N. A., pp. 293–297, 299–302, 311, 314–318. Carpenter—Geog. Reader, N. A., pp. 264–284.

(F) Territories and Dependencies of the United States.

(*a*) Alaska.

Location; extent; latitude. Relation to other lands and waters. Islands.

Nature of the country. Highlands; lowlands; peaks and volcanoes. Only volcano active in U. S. on continent.

Distance from Washington coast. From Asia.

Climate. Why?

Products.

Seal. Review.

Gold—Nome.

Lumber. Why not utilized?

Salmon and other fish—Sitka.

Trade routes and markets.

Ref.:—R. & H.—Nat. Adv., pp. 91, map 10. Frye—Gram. Sch. Geog., pp. 120, 121. Tarr and McM.—N. A., pp. 323–330. Carpenter—Geog. Reader, N. A., pp. 298–306.

(*b*) All others.

Name and locate on outline map of world.

Porto Rico, Philippines, Hawaiian Islands, Guam, Wake, Tutuila, and the Manua Group.

Nature of each. Climate. Products. Cities. People.

Value to U. S. as source of raw materials, and as markets for our goods, or as coaling stations.

Ref.:—R. & H.—Nat. Adv., pp. 100, 142, 153, maps 23, 24. Frye—Gram. Sch. Geog., pp. 123–127. Tarr and McM.—N. A., pp. 330–348. Hill—Cuba and Porto Rico. Ober—Porto Rico.

Review by calling for topographic and climatic characteristics of states; their products and cities, their location, comparative size, and importance as producers to the nation. Compare states, physiographic regions, and cities. Have in mind the unity and diversity of the nation and the interdependence of its parts. Review transportation routes with products and cities, noting whither the products go, how, and why.

Ref. General List U. S.:—Adams—El. Com. Geog. Longmans—Geog. Keith Johnston—Geog. Lyde—North America. Shaler—Story of

Our Continent. Frye—Gram. Sch. Geog., Com. maps, pp. 75–85. Scribners—Statistical Atlas. Shaler—United States. R. & H.—Nat. Adv., pp. 57–61. Russell—Glaciers of N. A. Russell—Rivers of N. A. Russell—Lakes of N. A. Russell—Volcanoes of N. A. Statesman's Year Book. Commercial Relations of U. S., last Annual Rept. Stanford's Compendium. Gannett—The Building of a Nation. Baedeker—The United States. Twelfth Census Reports. Bryce—American Commonwealth. Cram—R. R. Atlas. Tarr and McM.—N. A., pp. 403–435. Tarr and McM.—Europe and other Continents, pp. 488–516, 523–541. Year Books, U. S. Dept. Agri.

3. Mexico, Central America, and West Indies.
   Position, with reference to other countries and waters; with reference to latitude and longitude.
   Surface features; mountains, plateaus, volcanoes, and coast plains.
   Climate; characteristics of. Altitude as a control. Healthfulness in different parts.
   Vegetation.
   Occupations and products as determined by climate and relief.
   Trade of Mexico—Exports and imports.
   Cities of Mexico; routes; countries receiving or sending goods. Mexican Central and Mexican National R. R.
   Trade of Central American Republics.
   As for Mexico.
   Name the republics and the colony in Central America.
   Leading islands and groups of West Indies.
   Products of them. Their imports.
   Their importance to the world, especially to the U. S.
   Whose possessions are they?

Ref.:—Frye—Gram. Sch. Geog., pp. 131–135. R. & H.—Nat. Adv., pp. 97–100. Tarr and McM.—N. A., pp. 378–400. Carpenter—Geog. Reader, N. A., pp. 327–350. Lyde—N. A., pp. 84–113. Hill—Cuba and Porto Rico. Johnston—Geog., pp. 432–438. Romero—Mexico. Adams—El. Com. Geog., pp. 247–256, 274–279.

4. Danish North America.
   Greenland, Iceland, and the Virgin Islands.
   Locate each.
   Character of surface of Greenland and Iceland.
   Glaciers; volcanoes, geysers.
   People and their contribution to the world.
   Why is the United States interested in the Virgin Islands?
   Advantages to us in possessing them.

Ref.:—Mill—Int. Geog., pp. 805, 806. Frye—Gram. Sch. Geog., p. 132. R. & H.—Nat. Adv., pp. 95–97. Tarr and McM.—N. A., p. 372–376. Johnston—Geog., pp. 415, 416. Adams—El. Com. Geog., p. 207.

PRACTICAL EXERCISES IN PHYSIOGRAPHY

BY W. M. DAVIS
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THE general progress towards realistic work in school teaching, reënforced by the admission requirements of certain colleges, is promoting the addition of various practical exercises to a subject that until recently has all but universally followed the empirical method based on text-book and recitation. Physical Geography, or Physiography, has long been in fact as it is now coming to be in practice, rich in material that is available for laboratory and field study; but the teachers in whose hands the study is to-day entrusted generally labor under the disadvantage of having learned the subject in the old-fashioned way, and of having as yet no specific training in the practical exercises that are now coming to be demanded in the better schools. It is not possible to present a guide to such exercises in the limits of this article, but there are certain general suggestions that may be offered with the expectation of their being serviceable.

1. All practical exercises in physiography, as in any other subject, must bear the recommendation of being well worth doing: they must not be mere devices for keeping the hands busy. They must, moreover, lead to results that can not be so effectively reached in any other way. For example: Many illustrations of the physiography of the lands are found to-day on the contoured topographical maps of the United States Geological Survey. It requires some practice to read the maps; that is, to interpret the conventional device of contour lines into its meaning as land relief. This practice can not be gained by learning definitions of contour lines in a book; it can be gained only by practical exercises in making and in using contour maps. The exercises are well worth while, for they lead to the acquisition of valuable knowledge. It is, however, very desirable that the exercises should not take the form of abstract devices in preparation for some future use; they should be introduced at the time the first kind of land form is studied, and they should serve as a useful aid in studying it. My own practice is to introduce land forms with the class of coastal plains, because these are of all complete forms the simplest; hence, on opening this chapter of the subject, the construction and the use of contour maps, as means of better understanding coastal plains, are appropriate exercises; and these exercises are well warranted by their repeated application in later chapters of the subject,

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as well as by the practical value of the knowledge they provide for later years of life.

2. The number of available exercises in physiography is so large and the hours usually allotted to them in school programs are so few, that the time spent in laboratory and field exercises must be economized to the utmost. This involves much labor on the part of the teacher, but it is labor well bestowed. For example: In the construction of isotherms or isobars on weather maps, much time is commonly wasted by having the pupils enter thermometer or barometer readings on a blank map. This exercise is of little value, because it is monotonously elementary. The readings should be previously entered on the maps by means of some manifolding process; the pupils may then find profitable exercise in drawing isotherms or isobars as a graphic means of generalizing the distribution of temperature and pressure, in writing down a carefully prepared equivalent verbal statement, in comparing the quality of the graphic representation and verbal statement, and in learning the appropriate use of each method of record.

3. Mere copying is of little profit. The pupil's exercise should always involve some novelty of construction; otherwise the exercise becomes too largely mechanical. It is a waste of time to copy an isothermal chart of the world; but it is very profitable to search out on such a map and to enter on another map the regions where any peculiar features of temperature distribution occur, and then to write down their explanation. For example: What is the path of the mean annual heat equator? Where are the lowest and the highest temperatures on this line? Explain their occurrence. Trace the path of the heat equator in January; in July. Where is its migration greatest? Where is it least? In which hemisphere does the heat equator migrate farthest from the geographic equator? Explain all these facts.

The same principles apply in drawing maps of land forms. It is unprofitable merely to copy a map; it is extremely profitable to interpret a map. This may be done in several ways. One of the simplest is to redraw a contour map in hachures, or vice versa. Another is to draw a hachure or a contour map from a perspective block diagram or from a model; but care must be taken to avoid making these exercises difficult from over-elaboration, and to hold the pupil's attention on the essential features of the thing drawn rather than on the drawing. A third method, and one that is, to my mind, the most profitable of all in the systematic and disciplinary study of physiography, is to draw a map showing an earlier or a later stage of the form represented in the original

map. Given a stream in an incised meandering valley with narrow flood-plain scrolls, draw a map showing the valley form before the scrolls were developed or after they have reached a greater length and breadth; and write down the principles of land sculpture thus exemplified. Exercises of this kind will some day have a large share in replacing the vagueness from which physiography now suffers with a wholesome accuracy and definiteness.

4. Much profit comes from assigning different but equivalent parts of an exercise to different squads of pupils; the results are thus enlarged and time is saved without any sacrifice of useful practice. For example: In distributing maps on which isobars are to be drawn (and on which barometer readings are therefore already entered) let maps for successive dates be given to different squads. It is then possible to use the same maps afterwards in studying the movement of cyclonic and anticyclonic centers. Again, in graphic exercises on waves — usually unknown in schools to-day, but unknown for no sufficient reason — the problem of combining waves can be usefully distributed through ten or more squads, with the result of showing very prettily the changing form of the resultant waves, and thus explaining one of the most common and at the same time one of the least generally understood phenomena of the sea surface.

5. Certain subjects lend themselves easily to uniform treatment by a whole class, or by squads of a class, in a limited laboratory period. The materials are set forth on the tables at the beginning of the period, and the results are reached at the end of the period. Other subjects can not be so simply handled, and special arrangements must be made for them. For example: Evidence of the earth's rotation, as furnished by observations of the sun at different hours of the day, is best obtained by assigning observations at successive half hours to different pairs or groups of pupils; the results thus gained are of fundamental importance and of far-reaching application, and therefore accommodation should be made for making the observations that lead to them. Again, determination of magnetic declination is not very easily made by every member of a class; it may here suffice if a few determinations are made by certain members, compensation being made to the other members by allowing them the privilege of doing other individual tasks in due turn. There is one exercise that requires a year for the completion of the cycle of all its elements; the variations of the sun's midday altitude, of the time and direction of rising and setting, of the length of the day, and of seasonal temperatures, all belong together and should all be associated as conse-

quences of a common cause, namely, the annual movement of the earth around the sun. In order to reach this important generalization inductively without demanding too much work of any one pupil, the necessary observations may be subdivided and assigned to different squads of observers, thus ensuring sufficient practice for each squad without making the work too great in quantity or too monotonous in quality; or if desired, the teacher's records may be drawn upon to supplement those made by the pupil. Certain observations must be made out of school hours; those of sunrise and sunset, and of the place of the sun among the stars, are of this kind. What a travesty upon education is a school program where no such work is undertaken!

6. In nearly all exercises it is desirable that the results should be carefully formulated and written down; otherwise the exercise may not reach the head as surely as the hand. The relation of wind movement to the distribution of pressure, the relation of wave progress to water movement, the relation of land sculpture to the passage of time (inductively shown in many separate exercises) offer excellent practice in generalization and formulation; and laboratory work can not reach its full value if such practice is withheld. It should go without saying that the pupils ought to be held as responsible for the results thus attained as for any of the statements of a text-book.

7. Field work has certainly come to stay among us. Correspondence with teachers shows that it is becoming increasingly common every year, and that there are few cities so large as to make out-of-town excursions unfeasible. Excursions undoubtedly involve many difficulties, but the difficulties can be overcome if superintendent, master, and teacher all work together. On the way to and from the field of study, the ordinary rules of good behavior should suffice for the control of the party; when the field is reached, the stricter rules necessary for school discipline may be enforced; although, for that matter, few such rules are needed by a good teacher with a well-trained class, either indoors or out.

Excursions in the autumn are best devoted to the inculcation of the general principles of land sculpture; in the spring, attention may be given to such special forms of land and water as the school district offers. In both seasons, schools that are situated within the glaciated area of the Northern States are at a disadvantage compared to those farther south, where only the simpler processes of land sculpture by rain and rivers are encountered. The best means of lessening this disadvantage is for the teacher to obtain a comfortable knowledge of forms due to glacial action, so as to treat them easily and make the best of them.

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Care should be taken to make field work serious without making it difficult or obscure. Certain note books that have been submitted in satisfaction of college entrance requirements are very unsatisfactory in this respect; their records concern trifling matters and fail to reach worthy generalizations. Care should also be taken to connect the generalizations of field work with the generalizations of the text; otherwise the excursions will not be sufficiently useful in supplementing school study. In the spring excursions, it is very important to discuss the relations of the examples of land and water forms locally observed with examples of similar kinds elsewhere in the world, and to discuss their likenesses and differences in view of a systematic classification of land and water forms.

8. In all phases of practical work in physiography, it is of the highest importance that the pupils should be led to realize their own responsibility and their own capacity with respect to the world of nature. They may not make original discoveries, but they may repeat many famous discoveries, and gain an essentially first-hand knowledge of many facts and principles. It is entirely within their power to prove, on the basis of their own observations, planned and guided by the teacher, that the earth moves around the sun (or the sun around the earth) at a nearly constant rate in a nearly circular orbit once a year; that the earth rotates on an axis that is inclined about 23° from a vertical to its orbit; and that the change of the seasons results from these motions. The quality of the knowledge thus gained is of so high an order and is so encouraging with respect to the possibility of gaining more knowledge by direct appeal to nature, that the considerable share of time needed in getting this fundamental result is well spent. So with the deliberate study of the various kinds of land forms; the understanding that is gained of the elementary examples presented in a school course may be so thorough, and the principles that underlie the understanding may be so reasonably grounded, that the pupil must thereby be encouraged to trust himself in advancing towards new subjects of study; thus his intelligent independence is cultivated rather than his docility, while at the same time he is led towards a sympathetic appreciation of the world that he is to live in. Results of so great value as these give warrant enough for allowing a place in the school curriculum to any method that will secure them.

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THE SHAPE OF THE EARTH*

BY FOREST R. MOULTON
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MODERN RESULTS

DURING the past century the principal governments have carried out extensive surveys of their possessions, especially the coast lines, in various parts of the earth. The longest arcs so far measured are the ones stretching from Hammerfest to the mouth of the Danube, and the nearly equal Indian arc extending from the Himalayas to the southern end of the peninsula. Discussions of these various results have furnished the size and shape with a high degree of precision. No spheroid can be found which will satisfy all the measurements and, indeed, it is certain that the earth is no such simple figure as a spheroid. Nevertheless, it is simplest in practice to find the spheroid which most nearly coincides with it, and to describe the surface by its deviations from this figure.

In 1866 Colonel Clarke of the English Ordnance Survey made a very careful and accurate computation of the size and shape of the spheroid, and his results have been very generally used since. He found that the equatorial radius equals 3963.307 miles, the polar radius 3949.871 miles. For this spheroid a computation which can not be explained here shows that

At	the	equator	one	degree	in	latitude	equals	68.704 miles
"	latitude	20°	"	"	"	"	68.786	"
"	"	40°	"	"	"	"	68.993	"
"	"	60°	"	"	"	"	69.230	"
"	"	80°	"	"	"	"	69.386	"
"	"	90°	"	"	"	"	69.407	"

with an error not exceeding five feet.

The parallels of latitude are small circles and the length of a degree in longitude decreases from the equator to the pole. The appropriate computation shows that

At	the	equator	one	degree	in	longitude	equals	69.652 miles
"	latitude	20°	"	"	"	"	65.478	"
"	"	40°	"	"	"	"	53.431	"
"	"	60°	"	"	"	"	34.915	"
"	"	80°	"	"	"	"	12.134	"
"	"	90°	"	"	"	"	0.000	"

**Continued from The Journal of Geography, Vol. II, November, p. 481.*

A recomputation by Colonel Clarke in 1878 gave for the equatorial radius 3963.296 miles, and for the polar radius, 3949.790 miles, the difference being 13.506 miles.

ASSOCIATED PRACTICAL PROBLEMS

The foregoing figures depend upon the solution of two practical problems. The first is the measurement of the distance between the extreme stations, and the other the determination of their difference in latitude. The first is a problem of surveying and triangulation ; the second, one of practical Astronomy.

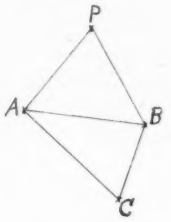


FIG. 3

It is much more difficult to measure accurately the distance between two stations which are far apart than one might suppose. The irregularities of the surface introduce many difficulties, and these are supplemented by others arising from the variations in the length of the measuring rods under changes in temperature and the trouble in putting their ends in contact without slightly displacing the one already in position. These sources of error are to a considerable extent avoided by triangulation. This consists in measuring an original distance, a base line, a few miles in length with the greatest precision possible, and then getting the remaining distance by the measurement of angles and the successive solution of a series of triangles. Thus (Fig. 3), suppose it is desired to find the distance from P to Q.

The distance from P to A is carefully measured, that is, determined with an error not exceeding an inch or two in ten miles. A point B is taken which can be seen from both P and A, and the angles $B\,P\,A$ and $P\,A\,B$ are measured with high grade surveyors' instruments. Then, having given two angles and the included side of the triangle, all of the

remaining parts can be computed by plane trigonometry. Next take a point C, which can be seen from both A and B, and measure the angles at A and B, which with the side $A\,B$ already computed determine this triangle completely. This process is continued until the point Q is reached, after which the direct distance $P\,Q$ can be computed.

The sources of error in addition to those in the base line $P\,A$ are in the many angles which must be measured. The irregularities in the refraction of light near the earth's surface make these troubles quite formidable.

The astronomical latitude of a place is the angle between the plane of the earth's equator and the direction of the plumb line. It is usually assumed in elementary books that this line goes through the center of the earth, but this is not true except at the equator and the poles. Since the direction the plumb line takes enters into the very definition of the latitude of a place, it is clear that any unusual local condition, such as neighboring mountains or deposits of exceptionally dense or light matter near the surface, might give results which would be discordant when applied to the whole earth. One would expect that the plumb line would incline somewhat toward a continent if it were hung near the shore, because the density of rock and soil is nearly three times that of water. Unfortunately there is no method of detecting such a deviation from the direction which a spheroid would give in the case of a single observation, and doubtless some of the discrepancies which have been found in comparing the very best measurements are due to this cause. Nevertheless, since the actual size of the earth is well known from many observations, if there is any rapid deviation it can be detected by measuring the distance between the two stations and their difference in latitude. If it should transpire that such measurements correspond to an earth of 6,000 or 10,000 miles in diameter, it would be known that local conditions are of such an unusual character as to strongly influence the direction of the plumb line. Some very remarkable examples of this character have been found sometimes even where there have been no apparent reasons for them.

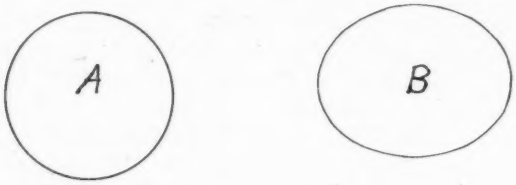
If it were not for local deviations of the plumb line the latitude of a place could be determined so accurately that the error would correspond to a distance of less than ten feet.

THEORETICAL SHAPE OF THE EARTH

As has been stated, Newton first predicted the oblateness of the earth from purely theoretical considerations. While he *proved* that the

equatorial diameter must be greater than the polar he only *assumed* that the figure is an oblate spheroid. The mathematical processes requisite for the solution of so difficult a problem were not fully developed until after Newton's death. Maclaurin first proved in 1740 that an oblate spheroid is a figure of equilibrium for a rotating homogeneous fluid, subject to no forces but the mutual gravitation of its parts. The ellipticity depends upon the mass, density, and rate of rotation. In fact, for a given mass, density, and rate of rotation not too great, there are two oblate spheroids which are figures of equilibrium. One is nearly round, as *A*, and the other much flatter, as *B*. (Fig. 4.) For greater values of the rate of rotation *A* is flatter and *B* is rounder, and for a certain rate of rotation the two figures become the same. For a greater rate of rotation no spheroid is a figure of equilibrium.

FIG. 4



An ellipsoid with three unequal axes was shown by Jacobi to be also a figure of equilibrium when the rotation is not too fast, and more recently Poincaré has proved that there is an unlimited number of others. In the case of a body subject, like the earth, to all sorts of disturbances, it seems reasonable that the form assumed will be that which is the most table, and this is probably the rounder oblate spheroid.

If the body is heterogeneous like the earth, it does not in the least follow that its figure will be an oblate spheroid. Indeed, if it is made up of a number of separate fluids of different densities, it can not possibly take this form. This theorem was proved by Hamy in 1887. However, if the densities do not vary greatly, the figure of equilibrium may differ only a very little from a spheroid. In order to determine theoretically the precise shape of the earth it would be necessary to know the density in all its parts.

It might be supposed that since the earth has a high degree of rigidity the figure might be quite different from one of equilibrium, but if so large a body departed to any considerable extent from such a form, the internal stresses due to gravitation would be so great that they could

not be withstood. The continental elevations are of relatively small consequence on a body the size of the earth.

SHAPE AND SIZE OF THE EARTH DETERMINED BY PENDULUM OBSERVATIONS

The weight of a body is the resultant of the earth's attraction for it and the centrifugal acceleration caused by the earth's rotation. The attraction depends upon the shape of the earth and the distribution of its mass; the centrifugal acceleration upon the rate of rotation, and the distance of the place of observation from the axis of rotation. If the surface is one of equilibrium, the resultant is always perpendicular to it.

It is a well-known fact, first proved by Newton, that a sphere attracts an exterior particle as it would if its whole mass were concentrated at its center. It is sometimes thought that an exterior particle is attracted by a body of any shape as though its whole mass were at its center of gravity, or at least, that the direction of the resultant attraction passes through the center of gravity, but this is erroneous except in a few special cases. The problem of finding the direction and amount of attraction of a body is generally one of much difficulty, and it is essentially involved in the determination of the shape and size of the earth by pendulum experiments. If the shape is assumed to be that of an oblate spheroid, the work becomes much simplified.

The centrifugal acceleration is very easy to compute as it varies directly as the product of the distance from the axis of rotation and the square of the angular velocity of rotation.

The object of pendulum experiments is to determine the constant of gravity, or the weight of a unit mass, at the places of observation. It is quite evident that the time of oscillation depends upon the forces acting upon the bob. The formula for the time of a single swing of the pendulum is $t=\pi\sqrt{\frac{l}{g}}$, where t is the time, l the length of the pendulum, and g the resultant of the earth's attraction and the centrifugal acceleration. If t is observed and l is measured, the value of g is given by the equation $g=\frac{l^2}{\pi^2 l}$. Now g does not vary much in different latitudes, and it would be quite impracticable to attempt to test it with sufficient accuracy by any such means as the use of a spring balance. Likewise, the effect upon the time of a single oscillation of a pendulum is small, but in this case it is quite as simple to use the accumulated results of many oscillations after which the change is easily detected. Suppose, for example, that a pendulum which will oscillate in seconds in one place is taken to another where the time of one swing is $\frac{1}{100000}$ of a second less. In a day (86,400 seconds) it will have gained $\frac{86}{100}$ of a

second, a quantity easily observed, and in ten days more than eight seconds. As a matter of fact, the greatest difference, which is between the equator and the pole, is about $\frac{1}{190}$ of the weight, corresponding to a difference of nearly $\frac{3}{1000}$ of a second in a second's pendulum. The gravitation is less at the equator than at the pole, because the attraction there is a little less, and also because the centrifugal acceleration is greatest at the equator and zero at the pole.

It is evident that there must be some method of measuring the time of the pendulum oscillations. This is very easily done by comparing it with the apparent revolutions of the fixed stars. Such comparisons can be made in a fixed observatory with an error not exceeding a tenth of a second of time, and when this is distributed among the seconds in the several days which may have intervened between the observations, it becomes absolutely inappreciable.

In this manner g, the resultant of the earth's attraction and the centrifugal acceleration, may be determined at any desired place. From such observations alone, if made at a sufficient number of stations, both the size and shape of the earth can be found. This fact is worthy of notice, for the statement is frequently made that pendulum experiments will enable one to determine the shape of the earth but not its size. It should be said, however, that the mathematical difficulties are such that it can scarcely be used without some hypothesis respecting the general character of its form, or in conjunction with measurements of arcs.

ASTRONOMICAL METHODS

There are a few purely astronomical phenomena which depend upon the oblateness of the earth and from which it may be computed, though by the means of difficult mathematics.

The simplest and most efficient of these methods is based on the precession of the equinoxes. The plane of the earth's orbit is very nearly fixed, though varying slightly as a result of the attractions of the other planets. But the plane of the earth's equator rotates backward with respect to the plane of the earth's orbit, completing a circuit in about 26,000 years. This rotation, first explained by Newton, is caused by the attraction of the sun and moon on the earth's equatorial bulge, tending to pull it down into the plane of the earth's revolution. The rate of this rotation depends upon the inclination of the plane of the equator to that of the orbit and the amount of bulging. If the rate and inclination of the planes are found from observation, the amount of bulging can be computed. The variation of density in the bulge, which

is a vital factor in the problem, is not exactly known and gives rise to considerable uncertainty in the solution.

Another method, of less value, depends upon the change the bulge makes in the motion of the moon. A body exterior to a sphere is attracted as though the mass of the sphere were all concentrated at its center, but an oblate spheroid attracts a body near the plane of its equator with a greater force than it would if its mass were all at its center. This difference becomes relatively less the farther the attracted body is away. Consequently as it moves around the spheroid in an orbit nearly elliptical the force does not vary strictly as the inverse square of the distance, and this changes the orbit in a perfectly definite way. The most conspicuous of these changes is a rotation of its axis in the direction in which the satellite revolves. In the case of the earth and moon this change is so small and so involved with others, due to the attraction of the sun, that it is impossible to obtain with any high degree of accuracy the oblateness from this disturbance. However, in the case of Jupiter and the very near fifth satellite discovered by Barnard in 1892, the method is quite satisfactory. It becomes so from the fact that the sun's disturbing influence is slight because of its distance, while the oblateness of Jupiter is very great, owing to its rotation on its axis in less than ten hours.

CONCLUSIONS

The earth is quite nearly, though not exactly, an oblate spheroid having an equatorial radius of 3963.3 miles and a polar radius of 3949.8 miles, a difference of 13.5 miles. The ellipticity is the difference of the axes divided by the larger one, or about $\frac{1}{300}$. These results have been obtained, in the first place, by the measurement of arcs, a process depending upon geometrical principles alone; in the second place, from the theory of the figures of equilibrium of rotating fluids, a process giving only the shape when the mass and density are known; in the third place, by pendulum experiments, a process involving the laws of mechanics in the theory of the motion of the pendulum and depending upon the internal variations of density; and finally by the astronomical methods which depend upon the laws of motion, the law of gravitation, and the interpretation of astronomical phenomena. These results have been won by a multitude of workers from Eratosthenes to the present time. Astronomical observations are required in all the different methods, and in most of them the correctness of the principles of dynamics is involved. The close agreements of the results not only prove that they are very exact, but it gives a confirmation of the principles used in deriving them.

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GEOGRAPHICAL NOTES

Iceland, the Heroic Nation.– Icelandic industries are chiefly confined to fishing and farming. Six million pounds of codfish, 7,000 pounds of eider-down, about 5,000 head of ponies, and nearly a half million sheep make up the annual exports. Very little land is cultivated. Successive years of frost and rain have washed out furrows so deep that great humps stand out on the surface, which from a distance look like heaps of hay. From these the farmers literally shave, with short scythes, enough grass to feed their sheep and ponies during the winter months. Potatoes and a few other vegetables are raised, but the summer seasons are rarely long enough to ripen grain. All breadstuffs are imported. In early days Iceland abounded in good timber, but at the present time trees are almost a curiosity. A few mountain-ash are found in the north and east, but the tallest tree in the country is scarcely 30 feet high. In many districts there is a low growth of birch saplings, which, if protected from the sheep, would doubtless attain to mature growth.

The houses are generally built of timber brought from Norway, or of the turf, which extends its roots into the ground from 18 to 20 inches and is so closely woven as to resemble thick felt. In the latter case the gables are likely to be of wood. The farmhouses are peculiar in that there are a number of small dwellings, one built against the other, with the gables all pointing in the same direction. These are connected on the inside by a common passageway. Until ten years ago there were no bridges nor regularly made roads. Now there are a number of bridges built according to the latest devices in engineering, and many miles of excellent road. The pony's back furnishes the only means of transportation; there are but one or two wagons in the country. The little ponies travel from one end of the island to the other, sometimes bearing loads almost as large as themselves. They are remarkably tame and possess almost human intelligence. Next to kith and kin the Icelander loves his pony, and many are the tales related of the faithful service of these little animals.—*Southern Workman*, October, 1903

Agriculture and Grazing in Alaska.—The special features of Alaska—its furs, fisheries, and gold mines—have been so frequently exploited by writers that an entirely erroneous idea has been conveyed as to the country's other diversified sources of wealth. That a grain-growing soil could be found so far north, with summers sufficiently long

to bring wheat to maturity, has not been supposed possible. Yet, as I have already said, not only has wheat been grown and successfully harvested wherever the experiment has been made, but even so far north as Fort Yukon, within the Arctic Circle, oats, rye, and barley are now grown regularly. The winters of Alaska are more hospitable than those of the great plains of Wyoming, Montana, and some parts of Nevada, and in the dead of winter horses and cattle can be worked without fear of being frozen. The temperature frequently is very cold, but there are no storms.

Except on the coast of Bering Sea, all the hardy vegetables are grown with marked success throughout Alaska and the Canadian Yukon south of the Arctic Circle. No finer potatoes, cauliflower, cabbage, kale, peas, lettuce, and radishes could be found anywhere in the United States than samples which I have seen grown at the Government experiment stations at Sitka and Kenai; and I have been told by a friend at Holy Cross Mission that he had eaten new potatoes, cauliflower, and other late vegetables in the month of July. At Rampart, in latitude 65°, winter rye, seeded there in August, lived through the winter perfectly, and matured grain by August of the following year. Barley seeded in May was ripe by the middle of August.

The great river valleys of Alaska and the Canadian North embrace cultivable areas large enough to form several good-sized States. All through the interior, in fact, there are to be found extensive tracts of grass lands, the growths from which, could there be a market for them, would exceed in value the products of all the gold mines. Along the route surveyed for the Alaska Central Railroad, from Valdez to Eagle, many large meadows, on which the grass was waving waist high, were traversed by the party of engineers. A number of horses were seen which had run at large in this region for two years.

Stock-raising is becoming an important Alaskan industry—within a very few years it is probable that regular shipments of cattle for export will be made. The extensive areas of rich growths of grass and the absence of storms in the winter make many sections of the country ideal places for ranching. The present summer is seeing an important step being taken in this connection. Several large stock-growers of Washington State are planning to convert the Aleutian Islands into vast cattle and sheep ranges, which will surpass in extent the rapidly diminishing ranges of Montana and Texas. One company has already begun the shipment of 25,000 sheep and 5,000 head of cattle to the Aleutians, a first consignment of 8,000 head of sheep having recently been sent from

San Francisco. The company had previously demonstrated that sheep will thrive there, living throughout the winter solely on the grass of the islands, by having landed 1,000 head there about a year and a half ago.—*World's Work*, October, 1903.

Railroads in Alaska.—Seward Peninsula, on which Nome is situated, is being rapidly "gridironed" by the various railroads built to communicate with the principal gold mines and with the other towns in that part of Alaska. The Alaska Central Railroad, the latest transportation enterprise, will run from Valdez, the most northerly port in Alaska, which is open all the year round, to Tanana, a distance of four hundred and thirty miles, and will open up the mineral and agricultural districts of the Copper, Tanana, and Yukon valleys. Construction has already begun on this line, the route lying through a country which is heavily timbered, with tributary territory rich in gold, copper, and coal. With a railroad projected, as a part of the Grand Trunk Pacific System, from Port Simpson to Dawson, with a hundred-mile line soon to be built from Dawson north, and with the Alaska Central coming east to Eagle City and west to connect with the Nome and Solomon City Railroad, it remains but a question of time when there will be all-rail communication from New York to Norton Sound, a few miles across Bering Strait from the continent of Asia. A northern spur from the Trans-Siberian Railway would then realize the once lightly regarded dream of "New York to Paris by rail."

The first railroad undertaking in the Far North was begun in southern Alaska and the British Yukon in 1898. In June of that year work was begun by a syndicate of English capitalists on what is now the White Pass & Yukon Railway, extending from Skaguay, in Alaska, to White Horse, Yukon Territory, a distance of 112 miles. It was constructed primarily to afford access to the gold fields of the Canadian Yukon, but has since been made a link in the continuous rail and river route to Northwestern Alaska and Seward Peninsula. The road was completed to White Horse in June, 1900, at places the cost of construction exceeding $250,000 a mile. The route had been used for pack-horses in the fall of 1897, but the trail was almost impassable, and immense numbers of the animals had died in their tracks. Two thousand had to be collected and burned with kerosene before the work could be undertaken. In attempting to lower Lake St. Louis about three feet, the entire lake washed away, causing widespread damage. The total cost of the White Pass Railroad was about $5,000,000; but it paid nearly $2,000,000 profits during its first two years' operations.—*World's Work*, October, 1903.

A Race of People who Live in the Sea.—Thursday Island is one of the most curious and interesting bits of land on the globe. It is the commercial center of a race of people who live practically in the sea. They are the pearl divers of the Pacific Ocean.

Thursday Island is one of the little group of coral formation lying between Australia and New Guinea. Taken together, the largest of these islands constitute a calendar, with an island for every day of the week, beginning with Sunday Island. Thursday Island commands Torres Strait.

Representatives of nearly all the nations of the Far East may be seen any day along its shores, disporting themselves in the water, Filipinos, Japanese, Chinese, East Indians, Fijians, and Papuans. To the right of the island, running for 1,200 miles down the Australian coast, is a stretch of waving green vegetation, apparently afloat upon the surface of the placid ocean. This is the top of the Great Barrier Reef, the most notable coral reef in the world. Throughout its length its banks are lined with pearl oysters.

Thursday Island forms the great market for these oysters. About $1,000,000 worth of shells are raised annually along the reef and on the western coast of Australia. The business of pearl fishing is conducted on the basis of the profit from the oyster shells. The pearls are clear gain, the value varying a great deal. One pearl found in 1890 sold for $10,000; another for $7,500. Pearls worth $100 are quite common.

The shells of pearl oysters are of enormous size, measuring frequently eighteen inches across. The oysters lie in the sea fastened to rocks, especially coral rocks, and quite away from sand and dirt. They hang by thread-like filaments, about a dozen in a bunch. The business of the diver is to cut this thread and bring up the oysters. The shells are worth from $500 to $1,000 a ton for the best; the poorest from $75 to $300 a ton. The natives trade them for merchandise and realize about $75 a ton on the average.

Fishing is done in small boats or luggars. Each boat has a pumping apparatus to force air to the divers under water. The smallest boat, with apparatus, is worth $3,000.

The business is very dangerous. Poisonous fish, sharks, and squid abound. Sharks rarely attack divers, but contribute immensely to their nervousness. Squid exude a quantity of inky black liquid which dangerously clouds the water.

Japanese are the best divers. They stay under water longer, dare more, and can be relied upon better than any of the other races.

Among the Malay natives women are successful divers. They go

down without diving suits, fastening stones to their feet to help them sink.

Natives and divers are not allowed to open the oysters. A careful watch is kept to prevent the theft of gems, under the eye of experienced foremen. A good operator can open a ton of shells in one day. It is supposed that a grain of sand getting underneath an oyster shell irritates the fish and causes it to exude carbonate of lime, which gradually coats the obstruction until a pearl is formed.

Attempts to obtain pearls artificially by slipping sand or glass under oyster shells have been unsuccessful.

The greatest pearl fisheries of the world are in the Indian Ocean. The product there is but one-tenth the amount of former years.—*The New World.*

What is Geography? — When so many geographers are expounding their conceptions of the content of the subject which they particularly study, it may not be amiss to add another to the many pages written on this topic. We are all anxious to arrive at some definite understanding on this point, in order to plan out both the research work of the university student and the application of the subject to teaching and other practical affairs. For school purposes it is not necessary to have hard and fast boundary lines round a subject. The Earth as the Home of Man is a most profitable point of view for the teacher. Professor Davis has lately somewhat widened this conception and expressed the work of the geographer as the study of what he calls physiography and ontography. This I think a very useful contribution, especially for those who consider geography as all physical or all descriptive and "political."

For some time I have suggested another way of regarding the field and work of the geographer. We may begin by defining geography as the science of distributions. The raw material of the geographer is the more or less finished product of the geologist, meteorologist, oceanologist, biologist, and anthropologist—finished sufficiently to be expressed in map form. In passing it may be noted that the maps summarizing the researches of these specialists do not as a rule emphasize the aspects of the subjects of greatest use to the geographer. The geographer takes distributional data from the work of these colleagues and compares, classifies, and interprets the interrelations of the whole. Geography is a synthetic science. The geographer must have the synthetic eye. Further he must have a macroscopic eye. He needs no microscope. He has to look as it were through the wrong end of the telescope and reduce his object of study. He is not concerned with dissection of the rock or plant or animal individual into its parts. He deals with a complex

association of solid rock, swirling air, flowing water, growing plant and animal and active man making here and there his mark on the landscape. Now the geographer does not regard this complex association as a jumble of parts any more than the human morphologist looks upon a man as a jumble of parts, but he sees them as a whole, a higher, more complex form of organism, which for want of a better term we might call a mano-organism, or in simpler terms a natural region.

This is the peculiar value of the geographical discipline—to see the larger divisions of the globe and to see them whole. Take away any element and the complete geographical form is mutilated. It is not earth considered alone and man considered alone, nor even earth and man considered in their relations one to the other, but earth and man as one organic, indissoluble whole, a more complex unity than we are commonly accustomed to think of; but one which we must in these days learn to recognize and to understand.

For teaching purposes the value of classifying the natural regions of the world into groups, and of paying special attention to a type form in each group and then examining the chief varieties will be found to be of absorbing interest and also a time-saving and invaluable educational discipline.—*A. J. Herbertson, Oxford.*

Royal Geographical Society's Syllabuses of Instruction in Geography.— In consequence of requests received from the London School Board and the Oxford and Cambridge School Examinations Board, the Council of the Royal Geographical Society appointed a special Committee to draw up syllabuses as guides to instruction in geography in elementary and in secondary schools. After careful consideration of the subject, the Committee requested the late Mr. T. G. Rooper, H. M. Inspector of Schools, and Mr. H. J. Mackinder, Reader in Geography at Oxford University, to draft the two syllabuses—the former that for elementary, and the latter that for higher schools. The sad death of Mr. Rooper deprived the Committee of his further valuable coöperation, and Mr. G. G. Chisholm consented to complete the revision of the elementary syllabus. The following is a very condensed outline of the syllabuses:

I. IN ELEMENTARY SCHOOLS

Geography has three main functions: (1) The determination or ascertainment, (2) the expression, and (3) the estimation or valuation of local conditions and place relations, that estimation or valuation having reference to the degree and extent of the influence which given local conditions and place relations exercise on other distributions, especially

human distribution, and hence on the life of man generally. Directly or indirectly, human interests determine what it is most important to observe, and what, therefore, it is most important to set down in descriptions and on maps. This idea, therefore, should always be present in the mind of the teacher as a guide, not merely as to what he should endeavor most strongly to impress on the minds of the learners, but also as to what he should omit, so as not to overburden their memories or confuse their minds. In the earlier stages it is not necessary for children to know where they are being led; it is enough if what is imparted to them serves to put them on the right road.

a. PRELIMINARY STAGE

For Children between Five and Eight Years

At this stage children listen with eagerness to narratives of adventure by land and sea. For this purpose, it is best to make use of suitable extracts from books of famous travelers.

The readings should be accompanied by simple explanations of geographical terms used in the narratives, and descriptions illustrated by models, figures made with the aid of sand-trays, etc., and the children themselves should be practiced in modeling. But the teaching of geography at the first stage will have fulfilled its main purpose if it has been attractive, and has made the children think of other countries besides their own.

b. FOUNDATION FOR SYSTEMATIC STUDY

Children between Eight and Eleven Years old

It is a serious difficulty in geography that the mind has to deal with facts that can not be directly observed. Hence arises the necessity for representing on a map the facts of Nature which are the real subject of study. It is important that the learner should realize—first, that geography is actually based on the observation of Nature, and, second, how the map is connected with such observations. It is of vital importance to lay a foundation for geographical teaching on the actual observations of the children themselves. This is what is referred to above as the first function of geography; but the third function, the estimating of the influence of local conditions and place relations chiefly on human life, will always be kept in view in telling children what to look at.

Geographical Observations within the Reach of Town Children

From the first children should be made familiar with the globe, which makes intelligible a number of observations which even town children can make for themselves—*e. g.*, the apparent movements of the sun.

Town children, equally with country children, can acquire from their own observations the idea of direction, and can be shown how direction is represented on a map; for streets serve this purpose as well as roads. They can also be taught to understand, with the aid of their own observations, the importance and the mode of representing differences of elevation on maps; for most towns have sloping streets as well as level, or nearly level, streets. With the aid of their own observations they can be most easily taught to understand contour-lines.

Where there are rivers, the teacher can show how they prevent communication by land except where they are bridged. This shows them how water may hinder communication; but they can also learn at river banks or on ponds in town parks how water may also assist communication, and so get some idea of the advantages of rivers, seaports, and canals.

Many of the important changes which regularly or from time to time modify the value of local conditions, and even place relations, can also be observed in towns. Children can notice the rise of water and its rapid flow in gutters during heavy rains, and see how it is deposited in the streets when the rain is over. They know the difference between winter and summer, and could be made to observe that some plants do not thrive in cold summers, and that even in summer plants are apt to wither in droughts unless they are watered. They may, therefore, be taught that where both warmth and moisture are found vegetation is likely to be abundant and varied. They can learn from observation the advantages of a southerly aspect, and can be taught to observe the difference between cold and warm winds, and the advantage of shelter from cold winds.

Then town children know that things are bought in shops, and that some of these—eggs, milk, butter, flour, fruit—come from a distance; and even London gardens and parks may assist in giving them some idea of the different aspect presented by the districts in which such things are produced from that of the town in which they are sold.

Observations more easily made by Children in the Country

Children should learn to take the bearings of objects from the tops of hills, and to plot their observations on paper, aided by Ordnance maps of various scales. Great pains should be taken to get the children to understand the different degrees of generalization in the representation of the country on different scales. On the more comprehensive smaller scale maps parallels of latitude and meridians are of course marked, and the practical use of a knowledge of latitude and longitude in indicating positions may be explained before the study of mathematical geography. With the aid of a contour map a relief model of the district may be con-

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structed. The frequent attention, in the course of walks, to river banks and hillsides will lead to the observation of the flow of water, and the way in which rivers hollow out valleys, receive tributaries, and spread out mud into plains. Special attention should be called to such actions of rivers as tend to modify their value for man. On the one hand, the great fertility of flood-plains should be pointed out; but on the other hand, children should be taught to notice that deposits make rivers shallower in different places, and thus made to understand why constant dredging is required to keep navigable channels clear.

Connected with the observation of wind, the formation of mist, cloud, and rain should be noted. Quarries and railway cuttings will reveal variation of soil. It should be pointed out that woods, scrub and marsh, grassy meadows, cultivated lands, and varied types of agriculture depend on configuration, soil, and local climate, and their position should be shown on the maps made by the children. There may also be opportunities to show the connection between local conditions and other industries than agriculture. In some cases it may be found profitable to study, even at this stage, the parish boundaries with some care. Historical remains should, of course, be examined. Children should learn to trace the course of roads and railways from place to place, and to note where bridges are needed, where embankments, where steep gradients are avoided or necessitated, where "saddles" in a range of hills form a pass, where roads are made to deviate in order to avoid steep gradients, or to reach the easiest saddle or the most convenient bridge; and on this part of the work great stress should be laid. Such information, if obtained first-hand, renders the description of foreign lands and their products a subject for reasoning, not for mere memory.

Systematic Study of Geography with Maps as a Basis

In the study of maps the same ideas are to be emphasized as in observational work. Mountain and hill ranges should be considered first as hindrances to communication. It should be noted that where the country has varied surface features, the general slope of the land is more or less in accordance with the flow of the rivers, so that roads and railways run in much the same direction. The importance of rainfall and temperature with respect to agriculture, and of facilities for mining and manufactures, will not be overlooked. Even in the most elementary study of continents emphasis should be laid on the great facts that affect the distribution of population.

At this stage much use may be made of wall and lantern pictures, provided that they illustrate the value of local conditions or place relations.

c. SYSTEMATIC STUDY OF VARIOUS PARTS OF THE WORLD

Children from Eleven to Fourteen Years old

Additional observational work on convergence of traffic, and bridges.

In drawing up syllabuses for this stage it is not desirable to attempt to fix any hard and fast lines either as to the scope of the syllabus or the order of presentation; but it will be generally recognized that such a syllabus ought to provide at least for a general knowledge of the distribution of land and water, rainfall and temperature, and the main characteristics of the continents, and a more detailed knowledge of the United Kingdom, the more important parts of the British Empire, some of the countries of Western and Central Europe, and of the United States.

The important thing, however, is to note the main facts on which stress should be laid in the study of any of the regions mentioned. There should be a more detailed study of physical features, and of the importance of the lowest points and lines in mountainous and hilly country.

Boys and girls will now be better able to understand the laws affecting climate and learn to read physical maps; for instance, to note the effect of physical features on rainfall and on temperature. Climatic differences between our own country and other parts of the world should be emphasized, and, as far as possible, explained.

The study of the physical features with special reference to the means of communication will, in many cases, throw light on the position of towns, and afford the best means of fixing that position in the memory. It will lead to a better appreciation of the convergence of traffic at the mouths of great rivers.

Before they have reached the end of this stage boys and girls should be able to understand something of the influence which geographical conditions have exercised on history.

II. IN HIGHER SCHOOLS

It will lead to better results than are obtained at present if boys or girls be arranged in special sets for geography, as is now the custom for mathematics and certain other subjects.

The object of the teacher is to build up a conception of the surface of the earth as the product of interacting physical forces, in order that that surface may be intelligently viewed as the scene of social activities. It is therefore clear that the geographical teaching should be related to the teaching, on the one hand, of natural science, and on the other, of history. A frequent practice is to treat physical geography or physiography as an introduction to natural science, and for the rest to be con-

tent with the employment of atlases during the teaching of history. The result is that the two sides of the subject are not habitually connected in the mind of the pupil. The remedy probably lies in the teaching of geography, on a regional basis, with such a distribution of the physiographic explanations as shall not obliterate the regional interest. At every step in the treatment the learning of the topographical data, their physical analysis, and their application to the facts of human society, whether commercial, political, or historical, should be closely correlated.

It is suggested, by way of example, that the teaching of pupils in the four years between thirteen and seventeen might be arranged according to some such scheme as the following: In the first year, the study of a considerable portion of Britain, that surrounding the school; in the second year, the whole of Britain; in the third year, Europe, and perhaps the Mediterranean; in the fourth year, the remainder of the world. In each stage a comparison would constantly be made with that which preceded. The standards in treating of all Britain would be taken from the section of the country learned in detail, those for Europe would be taken from Britain, and those for the outer continents from Europe.

Meteorology versus Astrology:

WASHINGTON, D. C., Oct. 20, 1903.

Editor, Journal of Geography

Room 560, 160 *Adams St., Chicago*

DEAR SIR:—As the teachers of geography throughout the country frequently have occasion to teach a little meteorology or climatology, we must look to them to disseminate more correct views as to the nature and foundations of this branch of knowledge; particularly do we hope that they will do useful work in eradicating from the minds of the people that lingering belief in astrology which is so discreditable to an intelligent person. The stars and the moon do not regulate the weather; they have no appreciable influence of any kind upon it. The winds and the weather depend almost entirely upon the sun's heat, the rotation of the earth on its axis, and the irregular distribution of land and water. I had hoped that by this time, thirty years of daily weather maps and storm warnings might have educated my fellow citizens as to the proper method of studying our atmosphere; but the accompanying quotation is a sample of the letters that come to us from our Weather Bureau observers in all parts of the country:

"I have endeavored during my stay here to educate the people of this vicinity in meteorological matters by lectures and otherwise, at the expense of much personal inconvenience, and shall continue to do so.

However, it is slow work. The farmers of this section seem particularly ignorant and superstitious in regard to the weather, while the schools are as a rule below standard in science instruction. A gratifying increase in the use of the daily weather map, for purposes of instruction in the public schools of this section, has been noted during the past two years, and the work of this office has considerably increased. To facilitate educational interest in the work I have recently purchased a stereopticon, prepared a number of slides, and purchased others.

"As for the local daily paper, it is simply pandering to the popular taste for almanacs and fakirs. The editor once assured me, and also stated in an editorial, that he did not believe in 'Hicks' and similar 'prophets.' Nevertheless, the paper is loath to publish any item or article that casts reflection on so-called weather almanacs, of which there seem to be an unusual number circulated in this State, including Hicks', Greer's, Dunne's, Gathright's, Ayer's, and others.

"It is to be regretted that the local college, 'the oldest female college in the world,' has apparently, so far as the public is informed, tacitly indorsed 'Rev. Hicks.'"

In most ancient times astronomers were undoubtedly honest students of the celestial phenomena, and to man's interest in astronomy we owe immense additions to all branches of our knowledge. But astrology, or the supposed influence of the stars upon mundane affairs, is a modern "mystery" that is promoted by a class of men whose object is, not to add to our knowledge of nature and the works of God, but to prey upon men in their ignorance and superstition. Nothing but the most active exertions on the part of all students will dispel such ignorance and counteract its baleful influence. Especially must the school teacher not only teach new truths but actively combat error. It would be an instructive lesson if each teacher would report how many pupils in his class believe, or are taught at home, that the moon and stars influence terrestrial affairs; also, how many do not believe it, and how many are neutral or have no decided opinion on the subject.

CLEVELAND ABBE,
Editor Monthly Weather Review.
Weather Bureau, U. S. Dept. of Agriculture, Washington, D. C.

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GEOGRAPHICAL QUERIES

A CLEARING HOUSE FOR GEOGRAPHICAL WANTS AND DOUBTS

IT is hoped this department will prove of practical benefit to teachers of geography, opening a way for the solving of the many geographical problems which are constantly met with in the classroom. All questions received will be answered by specialists in the various methods of geographical work. We invite inquiries, criticisms, suggestions, and discussions. Address all communications for this department to:

EDWARD M. LEHNERTS, *Winona, Minn.*

(1) I have read with great interest your announcement of the new department to be devoted to the answering of geographical queries, and as you have so generously volunteered to answer all inquiries, I take the liberty of asking you to give me a brief statement of the value of geography as a school subject.

S. M. QUIGLEY,
Supt. of County Schools. Wabasha, Minn.

The value of any subject in the school course depends on the extent to which it helps to prepare the pupil for adult life by giving a practical education—not only practical in the commercial sense of preparedness for the problems of industrial life, but also in the larger sense of a more

complete and harmonious development of the soul and the mind and the body towards the realization of Christian character, right citizenship, and the best social life.

Measured by this standard, the educational value of geography must be marked high. It makes for refinement, character, and a broad philanthropy by bringing the child in contact with the earth and the heavens and revealing to him the beauty and grandeur of the Creator's work, as seen particularly in our physical environments; by explaining how various environments govern the occupations, the modes of life, and the mental and physical conditions of peoples the world over; and by showing how the consequent difference in productions brings about an exchange of commodities and results in the interrelations of peoples and individuals, the dependence of one person on another, and the interdependence of all. It gives culture by acquainting the pupil with the ideas, institutions, and culture of other peoples; and like travel, for which it is a substitute, it tends to produce breadth of mind and liberality of thought. It is a means for mental training; and, perhaps more than any other school study, it exercises and disciplines the observational power, the imagination, the memory, and the reason. It develops a spirit of investigation and gives an impetus to seek the truth. It is a valuable aid to other subjects, especially language work and reading; it is the gateway to the physical sciences, the key to history, and the basis of commerce. It gives the pupil a fund of information that will make his life more full and useful and will subsequently prove of daily value in conversation, in reading, and in business. It makes the pupil feel at home in the world he lives in; helps him to see that true citizenship is partnership in every good undertaking; and goes a long way towards placing him in proper relationship with Nature, Human Nature, and God. E. M. L.

(2) We have enough money to buy either a tellurian or a good globe, but not enough to get both. What do you advise us to do? We will appreciate your advice and would also like to have your opinion as to the best tellurians and globes on the market.

W. M. McG., Mason City, Iowa.

If, as your question seems to indicate, you are at present without a good globe, then by all means get the globe. A tellurian is at best not a very helpful piece of apparatus and is not needed by the skillful teacher. Of the several tellurians we have seen, not one deserves to be recommended for use in the school room. For further particulars as to globes consult any large school supply house in New York or Chicago. Catalogues may be secured for the asking. E. M. L.

(3) Please answer the following question and settle a dispute. Would a person living at the equator always see the sun rise exactly in the east and set in the west? I said he would, but our teacher maintained that he would not; and she has asked me to write to you.

J. W. S., Clerk of District No.—, Baraboo, Wis.

Your teacher is right. To an observer at the equator, the sun rises exactly in the east and sets exactly in the west on only two days in the year, about the 21st of March and of September. At the summer solstice it rises and sets twenty-three and one-half degrees farther north; and at the winter solstice, twenty-three and one-half degrees farther south than due east or west. E. M. L.

(4) Would a person traveling from the equator toward the south pole be going up or down? A. L., New York City.

Up is away from the pull of gravity; down is towards the pull of gravity. A person traveling over the earth would always be going at right angles to the pull of gravity, that is, along a level surface. A person can go up or down only when receding from or approaching the center of the earth. R. E. D.

EDITORIAL

THE CRITICISM OF GEOGRAPHY TEACHING

IN all the practice schools associated with the normal and training schools of the country practice teaching under criticism is an important and valuable part of the student teachers' training. In order, however, that such criticism should produce the best and most helpful results, teachers and supervisors should bear in mind that they are working for the future and not for the present; hence, that their criticisms should be constructed so as to give the best training in applying the general principles of education and the special principles applicable to the special subject under consideration. Therefore all criticisms, although based on the materials afforded by the lesson of the moment, should be given so that they are permanently of value in similar or dissimilar conditions. A great deal of the criticisms given by special teachers is devoted too much to details as such, and too little to details as phases of larger wholes, or as illustrations of broad principles, applicable frequently in all school work.

In geography, criticisms should be given first from the standpoint of

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good teaching, and second from the standpoint of good geography teaching. Here is where a special teacher may be led into error, through considering one subject as greater than any other, while the general critic may be similarly producing evil through lack of knowledge of the special problems pertaining to the special subjects.

Then again critics should bear in mind that though destructive criticism has its place, constructive criticism is far better and more far-reaching. To call a lesson bad or to emphasize the bad points unduly is dispiriting to the pupil teachers and leaves them still in doubt as to how to proceed toward betterment. On the other hand, destruction followed by construction, so that the relative values of the two plans of procedure are brought out, is stimulating and helpful because the pupil feels that he can see the reasons for the criticisms. Then the destructive criticism becomes a means of growth rather than a deterrent of growth, as is the case where it forms almost the whole of the criticism of any lesson or series of lessons. We should always leave our pupil teachers better able to use their knowledge next time and not weak-kneed and perhaps nervously unable to make another attempt because they anticipate failure. Courage and not fear is therefore inculcated and permanent good results.

REVIEWS

To California and Back. A Book of Practical Information for Travelers to the Pacific. By C. A. Higgins. Pp. x, 317. New York: Doubleday, Page & Company, 1903.

Higgins' "To California and Back" is a guide book to the Santa Fe route on the outward trip and the Central Colorado route returning. The book is well written; its content is well selected and accurate. It tells just what one wants to know about the several regions, and does so in simple rather than superlative words. The illustrations are usually good, though many of the marginal sketches are indistinct. An appendix contains valuable information as to good side trips, showing time to be allowed and approximate cost. This volume can be used with confidence, and should be a companion of any one following the routes described. R. E. D.

Agriculture for Beginners. By Charles W. Burkett, Frank L. Stevens, and Daniel H. Hill. Pp. xii, 267. Size, 7¼ x 5 inches. Boston: Ginn & Company, 1903.

This little book devoted to the elements of agriculture, the full title of which is given above, is a very readable and helpful volume, especially for those who want to make nature study and geography real in rural schools. The volume deals with The Soil, The Plant, How to Raise a Fruit Tree, The Diseases of Plants, Orchard, Garden and Field Insects, Farm Crops, Domestic Animals, Farm Dairying and certain miscellaneous topics. An appendix includes directions for spraying, formulæ for fertilizers, and a glossary.

Unfortunately the opening chapters on the soil are inadequate and misleading. The volume in general is very practical and interesting, is well illustrated, and is a distinct contribution to elementary education. R. E. D.

Longmans' School Geography. By George G. Chisholm and C. H. Leete. Seventh edition, revised. Pp. xii, 513. New York: Longmans, Green & Company, 1903.

The latest edition of the well-known Longmans School Geography has many good points, especially as a book for teachers. It is accurate and logical and contains a wealth of valuable information in a small space. The illustrations are few and not particularly good. The book is printed in clear type with catch words brought out in heavy-face type, but on the whole is rather formidable for children's use. One of the most helpful features of the book is the appendix, which contains an excellent index, a commercial index, seventy pages of questions arranged by country and by topic, and a series of topical studies. A valuable book of reference for teachers who desire a small and well-arranged volume that will give the most important features of a country in a small compass. As the book contains no maps it is not readily adapted for children's use except in the upper grammar grades in association with an atlas. R. E. D.

RECENT PUBLICATIONS

Central Europe, by Joseph Partsch. Pp. xiv, 358. New York: D. Appleton & Company, 1903.

Central Europe is the third volume to appear in Appletons' World Series devoted to the Regions of the World. It deals with the general and special geographical features of Central Europe from the standpoint of the physical geography as a basis Well illustrated with maps and diagrams. To be reviewed later.

Commercial Geography, by Jacques W. Redway. Pp. vii, 406. New York: Charles Scribner's Sons, 1903.

A well-illustrated and typographically attractive book. Treats the commodities of trade by groups according to affinity and then considers the economic conditions of the several countries of the world. To be reviewed later.

American History and Its Geographic Conditions, by Ellen Churchill Semple. Pp 466, with sixteen maps. Boston: Houghton, Mifflin & Company, 1903.

An inclusive and scholarly study of American history as related to geographic conditions; contains an excellent index, and a good bibliography A strong contribution to one phase of the anthropogeography of America, of value to the historian, the geographer and the general reader. To be reviewed later.

Geographic Influences in American History, by Albert Perry Brigham. Pp. xiii, 366. Boston: Ginn & Company, 1903.

An untechnical and somewhat popular account of the relation of geography and history in the United States. Adapted to general use and illustrated by maps and pictures. To be reviewed later.

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The Geography of Disease, by Frank G. Clemow, M. D. Pp. xiv, 624. London: Cambridge University Press, 1903.

An inclusive description of the geographical distribution of all the common surgical, skin, and parasitic diseases, in which it is attempted to show the geographical causes influencing such distribution. Valuable for the physician and the advanced student of the geography of man.

Tarr & McMurry's Geographies, Supplementary Volume on Texas, by E. G. Littleton. Pp. xi, 94. New York: The Macmillan Company, 1903.

An inclusive, well-ordered and helpful supplementary volume, in which there are many diagrammatic maps of value. The text is broken by frequent "review questions," to be answered from the text. These questions mar the pedagogical value of the book, because they are of little help to any one, and interrupt the continuity of the text.

Tarr & McMurry. Home Geography, Greater New York Edition. New York: The Macmillan Company, 1903.

The familiar first book of this well-known series, with a special appendix for Greater New York. Of little especial value outside of the area for which it has been particularly prepared.

NEWS NOTE

The Alaskan Boundary Decision.—The Alaskan boundary tribunal, composed of three American and three British commissioners, has completed its work at London, and by its decision the United States seems to be the gainer. The award gives the United States the islands of Kannaghunut and Sitklan in the Portland Channel. The mountain line adopted as the boundary clears all the bays, inlets, and means of access to the sea; thus giving the United States a complete land barrier between Canada and the sea from the Portland Channel to Mount St. Elias.

All that Canada gains is practically the islands of Pearse and Wales; and the strategic values of these are lost since the two islands awarded the United States command the entrance to the Portland Channel and the ocean passage to Fort Simpson. All Canada is much dissatisfied with the decision, and the United States is much rejoiced that the vexatious question has been so successfully settled for all time. It only remains now for the surveyors of the two governments concerned to run the lines so that they may be determined accurately ever after. (See map, page 498.)

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